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CRANKCASE SCAVENGED INTERNAL COMBUSTION ENGINE

Technical field

The subject invention refers to a crankcase scavenged internal combustion engine for a portable tool, such as a chain saw or a power cutter. It comprises a cylinder with a reciprocating piston that above itself delimits a combustion chamber and below itself delimits a crankcase volume with a crankshaft, and the crankcase volume contains at least air and a lubricant, e.g. oil.

Background of the invention

Portable tools such as chain saws or power cutters are used in many different handling positions even up side down. They are therefore usually crankcase scavenged and lubricant, e.g. oil is supplied to the crankcase. This lubrication system works in every handling position.

However, oil tends to collect in the crankcase so there is a surplus in the crankcase and tends to be a shortage for some lubricating places. By adding more oil this can of course be compensated for, but this will increase oil consumption and increase emissions of oil smoke in the exhaust gases.

There are even lubricating places that are very difficult to lubricate at all, e.g. a bearing on the crankshaft supporting a centrifugal clutch normally used for portable tools. Some tools use a sealed bearing that is pre-filled with grease. The seals will wear resulting in loss of grease and the shaft will corrode increasing the wear of the seals and the loss of grease and shortening the life of the bearing.

Other tools use a duct arranged in the crankshaft so that one end of the duct reaches the bearing area. The other end of the duct either ends in the crankcase to get oilmist there, or ends in the outer end of the crankshaft to be lubricated with grease occasionally. In both cases the efficiency is limited and also dirt easily fills the respective duct so that the lubrication will be decreased or stopped.

Purpose of the invention

The purpose of the subject invention is to substantially reduce the above outlined problems and to achieve advantages in many respects.

Summary of the invention

The above mentioned purpose is achieved in a crankcase scavenged engine in accordance with the invention having the characteristics appearing from the appended claims.

The crankcase scavenged engine in accordance with the invention is thus essentially characterized in that at least one duct provided with a check valve connects the crankcase volume, or a connected volume, with a lubricating place or an oil tank.

This means that in a very simple way oil or oilmist is collected where there is a surplus of oil. From there it is sent either to a lubricating place or it is recirculated to make better use, e.g. back to the intake duct or back to an oil tank. One of the ducts can be arranged as a return duct and be arranged from the lubricating place or from the oil tank back to the crankcase volume or to the connected volume.

As an example oil can be fed from the oil tank to a suitable location in the crankcase or a connected volume creating efficient lubrication. Thereafter it can be fed to a lubricating place and/or be fed back to the oil tank from a location in the crankcase where there is a surplus of oil, e.g. the bottom of the crankcase.

These examples show a more efficient lubricating system that makes it possible to reduce consumption of lubricant and reduce exhaust pollution resulting from the lubricant and/or create a more efficient lubrication.

In one embodiment the check valve and the duct it is arranged in, are arranged in a wall that delimits the crankcase volume or the connected volume.

In another embodiment the check valve and the duct it is located in are arranged in the crankshaft.

Further characteristics and advantages of the invention will be apparent from the description of preferred embodiments. The embodiments can be combined.

Brief description of the drawings

The invention will be described in closer detail in the following by way of various embodiments thereof, with reference to the accompanying drawing figures, in which the same numbers in the different figures state one another's corresponding parts.

Figure 1 is an essentially bisected elevated view of an internal combustion engine configured according to the teachings of the present invention. The crankshaft is however only bisected locally.

Figure 2 is an enlarged view of the bottom part of figure 1. It shows a second embodiment of a lubrication system for the engine. The right part of the crankshaft is bisected.

Figure 3 corresponds to figure 2, but shows a third embodiment of the lubrication system, and a possible fourth embodiment.

Figure 4 shows in strong enlargement a cross-sectional view of a check valve unit comprising a check valve and a throttling.

Description of preferred embodiments

As appears from figure 1, an internal combustion engine 1 is shown configured according to the teachings of the presently disclosed invention. It is a crankcase scavenged engine of the two-stroke type. It has no valves in the shown embodiments, but can have valves and be of two-stroke or four-stroke type or similar arrangement. It is usually a petrol engine using an ignition plug, that is not shown. A cylinder 2 houses a reciprocating piston 3 that above itself delimits a combustion chamber 4 and below itself delimits a crankcase volume 5 with a crankshaft 6. The piston 3 is connected to a crankshaft pin 23 by a piston rod 22. The crankshaft pin 23 is mounted in counterweights 24 and part of the crankshaft assembly. The crankshaft 6 is mounted in two crankshaft bearings 25, 26. It is sealed with two crankcase seals 27, 28. The engine has a number of scavenging ducts 14. All this is entirely conventional and will therefore not be further described.

On the right end of the crankshaft a centrifugal clutch 29 is mounted, and it connects or disconnects a transmission pulley 30, that is rotationally mounted on a crankshaft by way of a bearing 31 usually of a roller bearing type. This is a conventional arrangement for a power cutter, but of course the centrifugal clutch 29 could also drive a chain sprocket for a chainsaw. Different drive arrangements with or without a centrifugal clutch are of course possible.

The engine is arranged so that a lubricant 7, e.g. oil, is supplied to the crankcase 5. The lubricant could be supplied dispersed in the fuel and supplied in a conventional carburetor, or in a low-pressure injection system feeding an intake duct in a similar way as a carburetor does. However, the lubricant could also be supplied by itself from a tank using a simple pump or by a system of check valves it could feed the lubricant to the crankcase using the pressure variations in the crankcase due to the crankcase scavenging system. In the latter case the engine could have a direct injection system injecting only fuel into the combustion chamber 4 and scavenge air and the lubricant from the crankcase.

A duct 8 has a widened part 8' and in this widened part a check valve 13 is located. The part of the duct 8 with a smaller diameter can be used as a throttling, but this throttling can also be combined with the check valve 13 to form an integrated check valve unit 21, as shown in figure 4. Due to the pressure variations in the crankcase there will be a pressure variation between the two ends of the duct 8. The check valve 13 will only allow flow in one direction. If that direction is downwards in the figure air and lubricant will flow downwards to the lubricating place 15, and from there back to the crankcase volume 5. If there is no other connection the flow will take place through the crankshaft bearing 25. If, on the other hand the check valve is mounted in the other direction, the flow will take the opposite route, from the crankcase through the crankcase bearing 25 and through the duct 8. It is also possible to use a return duct 9 that is arranged from the lubricating place 15 back to the crankcase volume 5, or to a connected volume 14. The scavenging channel 14 is an example of a connected volume. A connected volume could also be an intake duct. In a crankcase scavenged engine the intake duct is connected and disconnected by the piston 3, or a check valve, a so called reed-valve. In this way

it is possible to supply a surplus of lubricant from a part of the crankcase volume 5 where it will serve no special purpose and supply it back to the intake duct. In this way it can make better use and thereby reduce the total consumption of lubricant and/or make the lubrication more efficient. In an engine with valves the connected volume could be a volume containing a drive mechanism for the valves. This is of course of particular interest for a four-stroke engine. But possibly also for a two-stroke engine with valves. Using a return line 9 gives a possibility to seal the crankshaft bearings 25, as shown in figure 2. This reduces the crankcase volume resulting in a power increase and/or reduced exhaust emissions. The lubrication of the bearing can also be better controlled using only ducts 11 and 10. It would also be possible to have a check valve 13 in the return line 9 in figure 1. There could even be two or three or more check valves in every duct. If there is no check valve in duct 9, this duct preferably has a smaller cross section area compared to duct 8 to reduce the flow in line 9. This could increase the flow of lubricant through the duct system 8, 9. Of course the check valves could be oriented in either direction so that the flow is either downwards through the ducts 8, 9 or upwards through these ducts.

Figure 1 also shows a nozzle 41 supplied with the check valve 13 and a tube 42. Therefore oil on the wall of the scavenging duct 14 and air with oilmist will flow through the tube 42 and back to the crankcase 5 or to a connected volume 14, such as the intake duct. The tube 42 is connected accordingly, but this is not shown. This oil would otherwise have reached the combustion chamber. Therefore oil consumption and exhaust emissions are decreased. The nipple 41 is situated preferably where there is plenty of oil but not so high that it is reached by exhaust gases.

Figure 2 shows a second embodiment of the lubrication system. A collecting cavity 19 is arranged in a delimiting wall 18 of the crankcase volume. It could also be arranged in the wall 18 of a connected volume. The check valve 13, or the duct that it is positioned in, 10, 10' connect to the collecting cavity 19. Lubricant 7 will fill this collecting cavity 19, partly or fully. A return duct 11 is arranged in the wall 18. In this way the duct 10 and its check valve 13 will contact a mixture having more lubricant 7 than was available in the first

embodiment. However, also in this embodiment the collecting cavity 19 could be arranged at the mouth of the duct 8, here shown as 8'. The collecting cavity could also be located in a connected volume, as explained earlier.

Figure 2 also shows another embodiment for lubrication. The check valve 13, and the duct 12 it is located in, are arranged in the crankshaft 6 and not in the delimiting wall 18. The check valve is arranged so that it gives flow outwards from the crankcase volume, and a connecting part of the duct 12 supplies oil from the center of the crankshaft to its surface below the bearing 31, in this case a roller bearing carrying the transmission pulley 30. In this way a mixture of air and lubricant is supplied to the bearing 31 and the area around it that forms the lubricating place 16. In this arrangement obviously air and lubricant is lost through the bearing. But it must be understood that the amount of lubricant necessary for this lubrication purpose is very small, and a throttling is arranged in the system to control that the correct amount is given. Preferably a check valve unit 21 according to figure 4 is used.

Figure 3 shows a third, and possibly a fourth embodiment, of the lubrication system. The duct 10 is in this case arranged so that the flow through the check valve 13 can leave the engine proper and go to an external lubricating place 17. It is here marked as a box, but it could be, of course, any kind of lubricating place, such as a bearing, a seal, wear surfaces or similar, that could use a small amount of lubricant. Transport from the engine proper to this external lubricating place 17 is arranged through a tube 33, which is mounted onto a nipple 32. In this embodiment there could also be a return duct entering into the crankcase or a connected volume, such as the intake duct. A further alternative embodiment is marked with dashed lines. In this case a similar tube 33 connects to the nipple 32, and leads to an oil tank 39. This can have a deaeration system in a conventional way. From this oil tank a line could go back to the engine crankcase volume 5, or to a connected volume 14, such as the intake duct, but this is not shown. In this way the lubricant is used more efficiently, as the surplus in the cavity 19 is used. This could make it possible to reduce the total amount of lubricant used thereby also reducing air pollution.

Figure 4 shows the check valve unit 21 consisting of the check valve 13 and a possible throttling 20. They are integrated in a compact unit that is easy to press into the duct. The check valve 13 contains a washer 34 that can seal against an abutment area 36 when the flow tends to go in the left direction. This prohibits a flow in this direction. In the other direction flow is possible according to the arrow 40. The flow goes around the washer 34, and through a spacer 35.

CLAIMS

1. A crankcase scavenged internal combustion engine (1) for a portable tool, such as a chain saw or a power cutter, comprising:
a cylinder (2) with a reciprocating piston (3) that above itself delimits a combustion chamber (4) and below itself delimits a crankcase volume (5) with a crankshaft (6), and the crankcase volume (5) contains at least air and a lubricant (7), e.g. oil, c h a r a c t e r i z e d in that at least one duct (8, 9; 10, 11, 12) provided with a check valve (13) connects the crankcase volume (5) or a connected volume (14) with a lubricating place (15, 16, 17) or an oil tank (39).

2. The engine as recited in claim 1, wherein one of the ducts is arranged as a return duct (9; 11) and is arranged from the lubricating place (15, 16, 17) or from the oil tank (39) back to the crankcase volume (5) or to the connected volume (14).

3. The engine as recited in claim 1 or 2, wherein the check valve (13) and the duct (8; 10) it is arranged in, are arranged in a wall (18) that delimits the crankcase volume (5) or the connected volume (14).

4. The engine as recited in claim 1 or 2, wherein the check valve (13) and the duct (12) it is located in, are arranged in the crankshaft (6).

5. The engine as recited in any of the previous claims, wherein the check valve (13) or the duct that it is positioned in (10), connect to a collecting cavity (19) arranged in a wall (18) of the crankcase volume or the connected volume.

6. The engine as recited in any of the previous claims, wherein the check valve (13) is located in a widened part (8';10') of the duct (8; 10) it is positioned in.

7. The engine as recited in any of the previous claims, wherein the check valve (13) and a throttling (20) are integrated into a check valve unit (21).

ABSTRACT

A crankcase scavenged internal combustion engine (1) for a portable tool, such as a chain saw or a power cutter, comprising:

a cylinder (2) with a reciprocating piston (3) that above itself delimits a combustion chamber (4) and below itself delimits a crankcase volume (5) with a crankshaft (6), and the crankcase volume contains at least air and a lubricant (7), e.g. oil. At least one duct (8, 9) provided with a check valve (13) connects the crankcase volume (5) or a connected volume (14) with a lubricating place (15).

Fig. 1

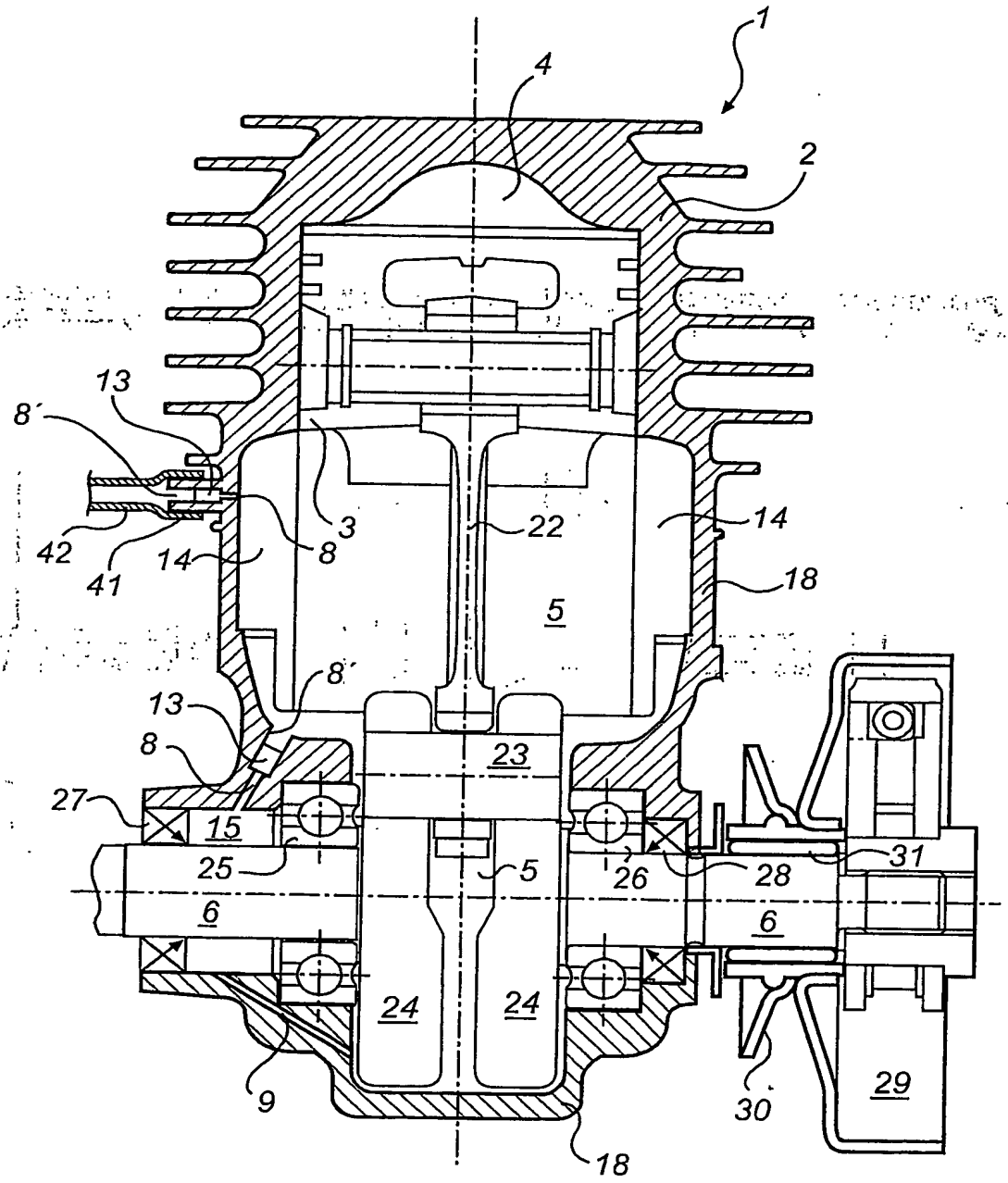

Fig. 1

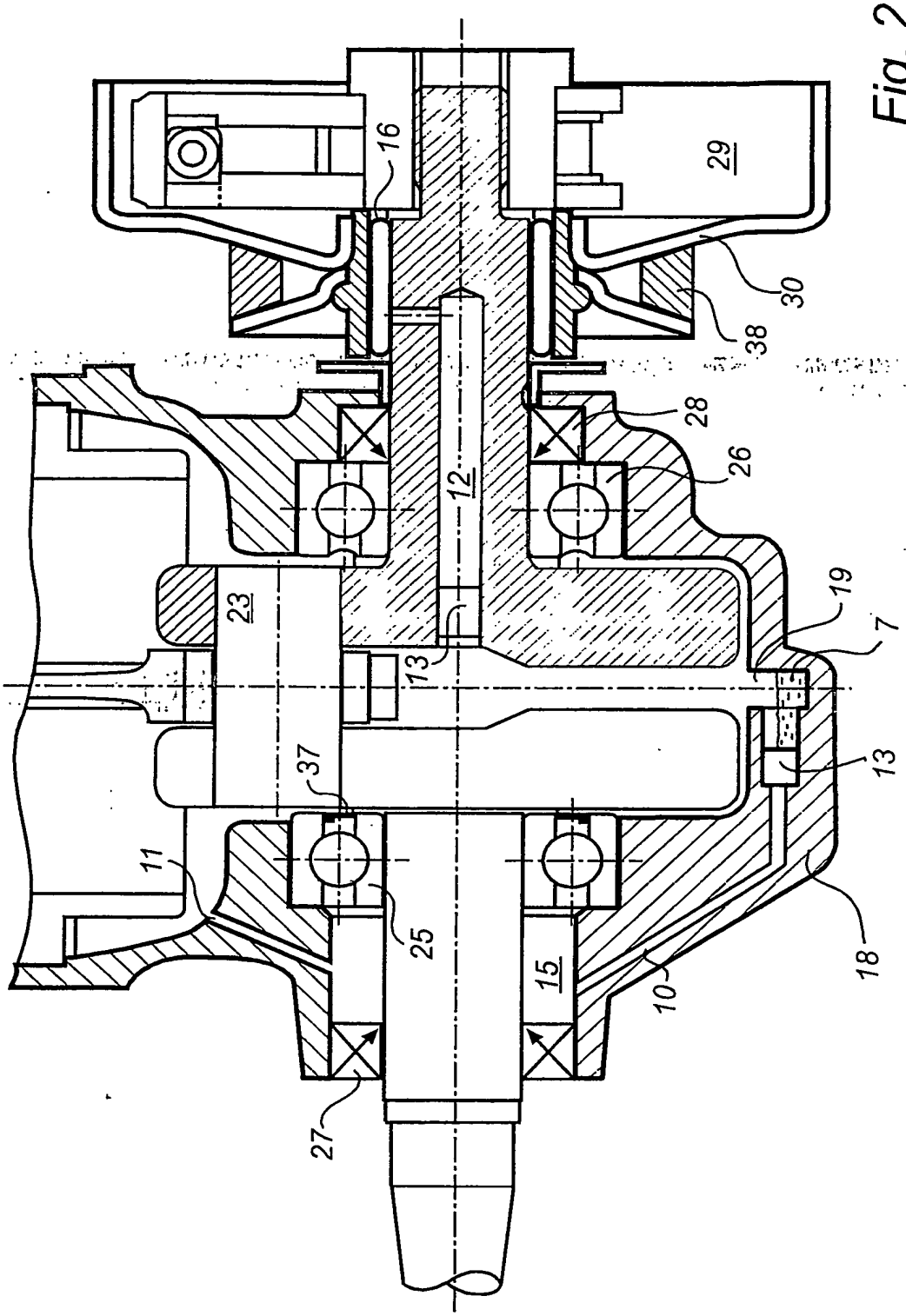

Fig. 2

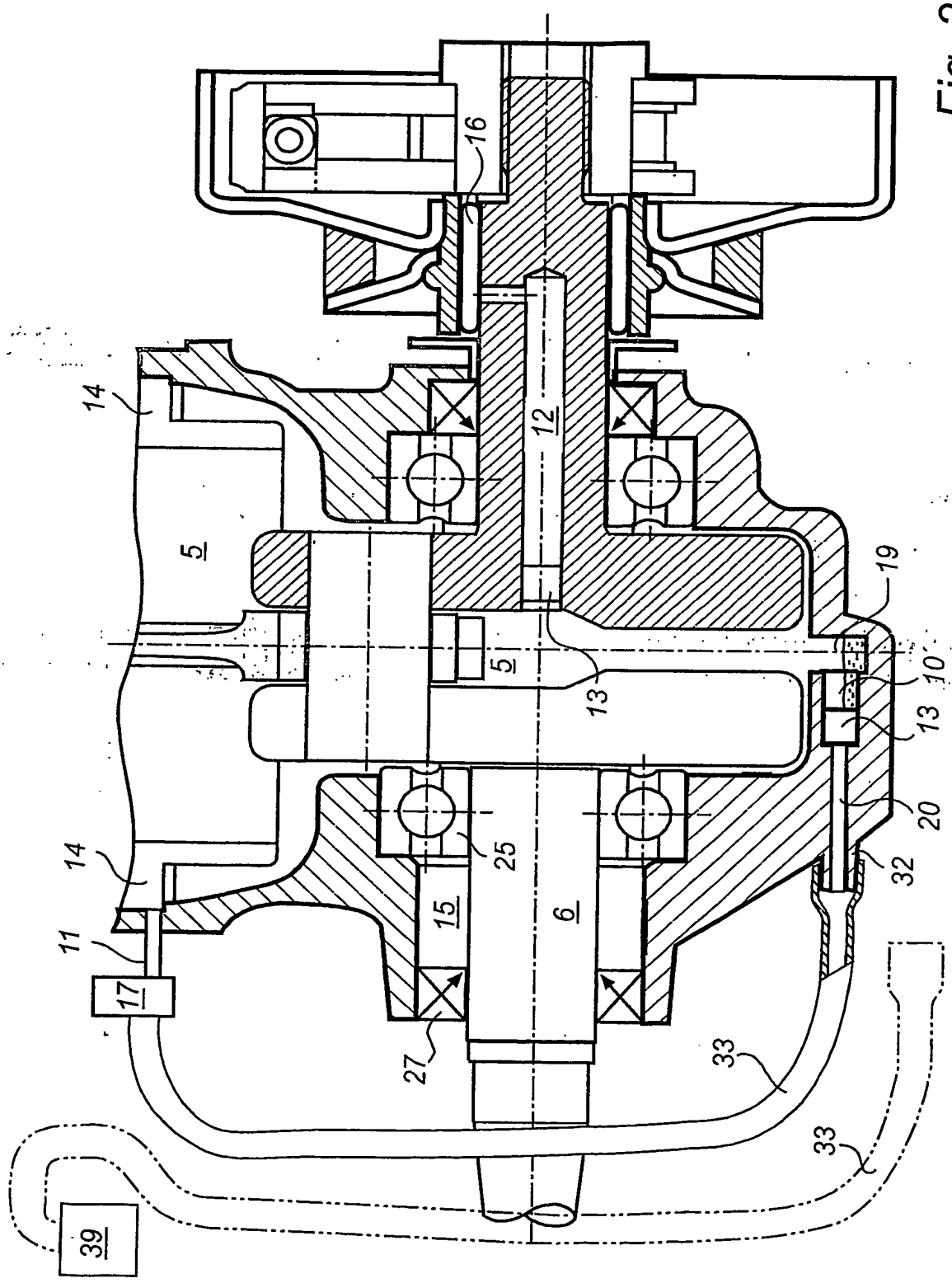

Fig. 3

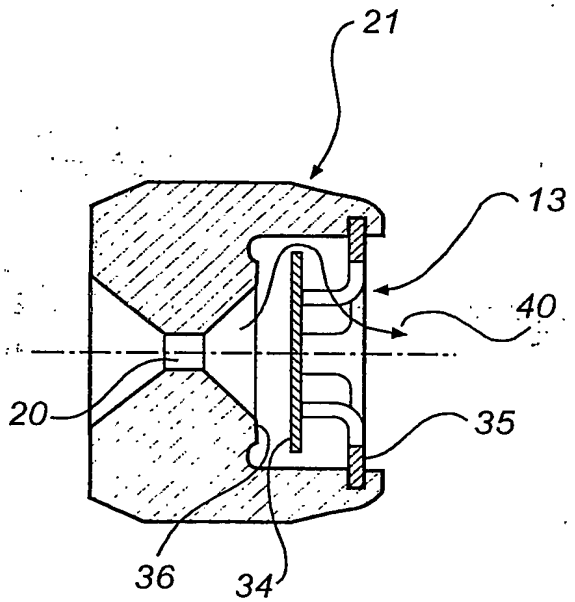

Fig. 4